#5

Practitioner's Docket No.: 791_126 CIP2B

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Yukihisa TAKEUCHI, Tsutomu NANATAKI and Koji KIMURA

Ser. No.: 10/027,775

Filed: December 20, 2001

Confirmation No.: 1603

For: OPTICAL SWITCH

Group Art Unit:

Examiner:

Box Missing Parts
Assistant Commissioner for Patents
Washington, DC 20231

I hereby certify that this correspondence is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 addressed to **Box Missing Parts, Assistant Commissioner for Patents, Washington D.C. 20231** on August 1, 2002 under "EXPRESS MAIL" mailing label number **EV 01907 1162 US**.

Janet M. Stevens

PRELIMINARY AMENDMENT

Sir:

Prior to examination, Applicants wish to amend the subject application as follows:

In the Specification:

Attached hereto as page 15, pursuant to Rule 1.121(b)(1)(iii) is a marked-up version of a specification paragraph showing the changes being made thereto. Attached hereto as page 16, pursuant to Rule 1.121(b)(1)(ii) is a clean version of the specification paragraph incorporating the changes being made thereto and containing instructions for replacing the paragraph in the specification.

In the Claims:

Please delete claims 1-47 in their entirety and add claims 48-94 as follows:

48. (New) An optical switch comprising at least a light transmission portion, an optical

path-changing portion and an actuator portion; wherein

the light transmission portion has a light reflecting plane provided on at least one part of a plane facing the optical path-changing portion to totally reflect light, and light transmission channels having optical wave guiding bodies and being provided in at least three directions with the light reflecting plane as a starting point;

the optical path-changing portion is provided in proximity to the light reflecting plane of the light transmission portion in a movable condition and has an optical path-changing member for at least reflecting or scattering light; and

the actuator portion has a mechanism that is displaced by external signals and transmits the displacement to the optical path-changing portion; characterized in that

the switching or dividing of an optical path is carried out by contacting or separating the optical path-changing portion to or from the light reflecting plane of the light transmission portion by displacement of the actuator portion in response to the external signals;

so as to totally reflect an input light from the light transmission channels at the light reflecting plane of the light transmission portion and transmit it to a specific light transmission channel on an output side when the optical path-changing portion is separated from the light reflecting plane of the light transmission portion;

or take out an input light from the light transmission channel, reflect or scatter it at the optical path-changing portion, and transmit it to a specific one or more light transmission channels on the output side when the optical path-changing portion is contacted to the light reflecting plane of the light transmission portion.

49. (New) The optical switch according to Claim 48, wherein

the actuator portion has:

a piezoelectric/electrostrictive element comprising a piezoelectric/electrostrictive layer and at least one pair of electrodes arranged on one part of the piezoelectric/ electrostrictive layer;

a vibrating member that is in contact with at least one part of the piezoelectric/electrostrictive element to support the piezoelectric/electrostrictive element and that converts strain of the piezoelectric/electrostrictive layer into bending displacement or vibrations;

a fixing member to fix at least one part of the vibrating member so as to vibrate the vibrating member; and

a displacement transmission member that is arranged between the optical path-changing portion and the piezoelectric/electrostrictive element based on needs, and transmits displacement of the piezoelectric/electrostrictive element to the optical path-changing portion.

50. (New) The optical switch according to Claim 49, wherein a ceramic substrate is constituted by unitarily firing the vibrating member and the fixing member, and a recessed portion or a hollow portion is formed in the ceramic substrate with giving the vibrating member a thin structure.

51. (New) The optical switch according to Claim 49, wherein the piezoelectric/electrostrictive element comprises a laminated body in which an anode layer having linking multiple layers functioning as anodes and a cathode layer having linking

multiple layers functioning as cathodes are alternately laminated with a ceramic piezoelectric/electrostrictive layer being put therebetween.

52. (New) The optical switch according to Claim 48, wherein the light transmission portion comprises two or more layers having different light refractive indexes.

53. (New) The optical switch according to Claim 48, wherein the light transmission channels of the light transmission portion comprise optical waveguides.

54. (New) The optical switch according to Claim 48, wherein the light transmission portion is configured by joining at least two optical wave guiding bodies to one optical wave guiding body so as to form light transmission channels into at least three directions, with the light reflecting plane of the light transmission portion as a starting point.

55. (New) The optical switch according to Claim 48, wherein a focusing lens or collimator lens is arranged at each of a plurality of light-signal input ends and/or light-signal output ends of the light transmission portion, and light signals are input and output through the focusing lens or the collimator lens.

56. (New) The optical switch according to Claim 48, wherein the optical path-changing portion has a light introduction member made of a transparent material.

57. (New) The optical switch according to Claim 48, wherein the optical path-changing portion has a light reflector for specularly reflecting light.

58. (New) The optical switch according to Claim 57, wherein the light reflector for specularly reflecting light is a light reflecting film that is integrally formed on a plane of the light introduction member on the side of the displacement transmission member.

59. (New) The optical switch according to Claim 48, wherein the optical path-changing portion has a light reflector for diffusely reflecting light or a light scattering body for scattering light.

60. (New) The optical switch according to Claim 48, wherein the optical path-changing portion is constituted only by a light reflector for diffusely reflecting light or a light scattering body for scattering light.

61. (New) A multichannel optical switch provided with a plurality of optical switches each comprising at least a light transmission portion, an optical path-changing portion and an actuator portion; characterized in that

the light transmission portion has a light reflecting plane provided on at least one part of a plane facing the optical path-changing portion to totally reflect light, and light transmission channels having optical wave guiding bodies and being provided in at least three directions with the light reflecting plane as a starting point;

the optical path-changing portion is provided in proximity to the light reflecting plane of the light transmission portion in a movable condition and has an optical path-changing member for at least reflecting or scattering light; and

the actuator portion has a mechanism that is displaced by external signals and transmits the displacement to the optical path-changing portion; wherein

the switching or dividing of an optical path is carried out by contacting or separating the optical path-changing portion to or from the light reflecting plane of the light transmission portion by displacement of the actuator portion in response to the external signals;

so as to totally reflect an input light from the light transmission channels at the light reflecting plane of the light transmission portion and transmit it to a specific light transmission channel on an output side when the optical path-changing portion is separated from the light reflecting plane of the light transmission portion;

or take out an input light from the light transmission channel, reflect or scatter it at the optical path-changing portion, and transmit it to a specific one or more light transmission channels on the output side when the optical path-changing portion is contacted to the light reflecting plane of the light transmission portion.

62. (New) The multichannel optical switch according to Claim 61, wherein each light transmission channel in a plurality of optical switches is formed of a single light transmission portion.

63. (New) The multichannel optical switch according to Claim 62, wherein each light transmission channel in a plurality of optical switches is crossed to each other and shares a part of each light transmission channel.

64. (New) The multichannel optical switch according to Claim 61, wherein one input-side channel is linked to one output-side channel in series as for each optical switch; and light that is input from an input end of optical switches, is switched at each optical path-changing portion of a plurality of optical switches.

65. (New) The multichannel optical switch according to Claim 61, wherein a plurality of optical switches are constituted by at least one optical switch having a plurality of input-side channels and at least one optical switch having a plurality of output-side channels, and one input-side channel is linked to one output-side channel between adjacent optical switches, switching the light input from input ends of a plurality of optical switches at the optical path-changing portion of the plurality of optical switches.

66. (New) A multichannel optical switch according to Claim 61, wherein a plurality of optical switches link one input-side channel to one output-side channel between adjacent optical switches by means of an optical fiber, switching at least the light input from input ends in an optical switch at each optical path-changing portion of a plurality of optical switches.

67. (New) A multichannel optical switch in which a plurality of the multichannel switches according to Claim 64 are arranged in a row.

68. (New) A multichannel optical switch in which a plurality of the multichannel switches according to Claim 65 are arranged in a row.

69. (New) A multichannel optical switch in which a plurality of the multichannel switches according to Claim 66 are arranged in a row.

70. (New) A multichannel optical switch comprising a plurality of the multichannel optical switches according to Claim 64; wherein each multichannel optical switch is arranged by locating at least one part of output ends themselves of each light transmission channel in each multichannel optical switch in an arc condition with an input end in an outer light transmission channel, which is disposed separately from each multichannel optical switch, at a center.

71. (New) A multichannel optical switch comprising a plurality of the multichannel optical switches according to Claim 65; wherein each multichannel optical switch is arranged by locating at least one part of output ends themselves of each light transmission channel in each multichannel optical switch in an arc condition with an input end in an outer light transmission channel, which is disposed separately from each multichannel optical switch, at a center.

72. (New) A multichannel optical switch comprising a plurality of the multichannel optical switches according to Claim 66; wherein each multichannel optical switch is arranged by locating at least one part of output ends themselves of each light transmission channel in each multichannel optical switch in an arc condition with an input end in an outer light transmission channel, which is disposed separately from each multichannel optical switch, at a center.

73. (New) A multichannel optical switch in which an optical divider or an optical coupler is joined to a light-signal input end or a light-signal output end of each light

transmission channel in the multichannel optical switches according to Claim 67 to branch or collect at least one part of the light transmission channel.

74. (New) A multichannel optical switch in which an optical divider or an optical coupler is joined to a light-signal input end or a light-signal output end of each light transmission channel in the multichannel optical switches according to Claim 68 to branch or collect at least one part of the light transmission channel.

75. (New) A multichannel optical switch in which an optical divider or an optical coupler is joined to a light-signal input end or a light-signal output end of each light transmission channel in the multichannel optical switches according to Claim 69 to branch or collect at least one part of the light transmission channel.

76. (New) A multichannel optical switch in which an optical demultiplexer filter or an optical multiplexer is joined to a light-signal input end or a light-signal output end of each light transmission channel in the multichannel optical switches according to Claim 67 to branch or collect at least one part of the light transmission channel.

77. (New) A multichannel optical switch in which an optical demultiplexer filter or an optical multiplexer is joined to a light-signal input end or a light-signal output end of each light transmission channel in the multichannel optical switches according to Claim 68 to branch or collect at least one part of the light transmission channel.

78. (New) A multichannel optical switch in which an optical demultiplexer filter or an optical multiplexer is joined to a light-signal input end or a light-signal output end of each light transmission channel in the multichannel optical switches according to Claim 69 to branch or collect at least one part of the light transmission channel.

79. (New) A multichannel optical switch in which each output end or each input end of a plurality of the multichannel optical switches according to Claim 64 is linked to a plurality of input ends or output ends in at least another multichannel optical switch.

80. (New) A multichannel optical switch in which each output end or each input end of a plurality of the multichannel optical switches according to Claim 65 is linked to a plurality of input ends or output ends in at least another multichannel optical switch.

81. (New) A multichannel optical switch in which each output end or each input end of a plurality of the multichannel optical switches according to Claim 66 is linked to a plurality of input ends or output ends in at least another multichannel optical switch.

82. (New) The multichannel optical switch according to Claim 61, wherein the actuator portion comprises:

a piezoelectric/electrostrictive element having a piezoelectric/electrostrictive layer and at least one pair of electrodes arranged on one part of the piezoelectric/ electrostrictive layer;

a vibrating member that is in contact with at least one part of the piezoelectric/electrostrictive element to support the piezoelectric/electrostrictive element and

that converts strain of the piezoelectric/electrostrictive layer into bending displacement or vibrations;

a fixing member to fix at least one part of the vibrating member so as to vibrate the vibrating member; and

a displacement transmission member that is arranged between the optical path-changing portion and the piezoelectric/electrostrictive element based on needs and transmits displacement of the piezoelectric/electrostrictive element to the optical path-changing portion.

83. (New) The multichannel optical switch according to Claim 82, wherein a substrate of ceramics is constituted by unitarily sintering the vibrating member and the fixing member, and that a recessed portion or a hollow portion is formed in the substrate with giving the vibrating member a thin structure.

84. (New) The multichannel optical switch according to Claim 82, wherein the piezoelectric/electrostrictive element comprises a laminated body in which an anode layer of linking multiple layers as anodes and a cathode layer of linking multiple layers as cathodes are alternately laminated with a ceramic piezoelectric/electrostrictive layer being put therebetween.

85. (New) The multichannel optical switch according to Claim 61, wherein the light transmission portion is configured by joining at least two optical wave guiding bodies to one optical wave guiding body so as to form light transmission channels into at least three directions, with the light reflecting plane of the light transmission portion as a starting point.

86. (New) The multichannel optical switch according to Claim 61, wherein a focusing lens or collimator lens is arranged at each of a plurality of input ends and/or output ends of the light transmission portion, and light signals are input and output through the focusing lens or the collimator lens.

87. (New) The multichannel optical switch according to Claim 61, wherein the light transmission portion comprises two or more layers having different light refractive indexes.

88. (New) The multichannel optical switch according to Claim 61, wherein a light transmission channel comprising an optical wave guiding body is formed at one part of the light transmission portions.

89. (New) The optical switch according to Claim 61, wherein the optical path-changing portion has a light introduction member made of a transparent material.

90. (New) The optical switch according to Claim 61, wherein the optical path-changing portion has a light reflector for specularly reflecting light.

91. (New) The optical switch according to Claim 90, wherein the light reflector for specularly reflecting light is a light reflecting film that is integrally formed on a plane of the light introduction member on the side of the displacement transmission member.

92. (New) The optical switch according to Claim 61, wherein the optical path-changing portion has a light reflector for diffusely reflecting light or a light scattering body for scattering light.

93. (New) The optical switch according to Claim 61, wherein the optical path-changing portion is constituted only by a light reflector for diffusely reflecting light or a light scattering body for scattering light.

94. (New) The multichannel optical switch according to Claim 61, wherein each optical path-changing portion has a light reflector, and at least two kinds of specular reflection angles are shared among the optical path-changing portions.

In the Abstract:

Attached hereto as pages 17-18, pursuant to Rule 1.121(b)(1)(iii), is a marked-up version of the Abstract showing changes being made thereto. Attached hereto as page 19, pursuant to Rule 1.121(b)(1)(ii) is a clean version of the Abstract incorporating the changes being made thereto. Please replace the original Abstract with the new Abstract attached as page 19.

REMARKS

Prior to examination, Applicants respectfully request entry of this Amendment in which the specification and abstract have been amended to correct minor informalities. Pursuant to 37 C.F.R. § 1.121(b)(1)(iii), a marked-up version showing the amendments thereto is attached. No new matter has been added.

Claims 48 - 94 are pending herein. Claims 1 - 47 have been cancelled in favor of new claims 48 - 94. No new matter has been added. Applicants believe the case is now in condition for examination.

If the Examiner believes that contact with applicants' attorney would be advantageous toward the disposition of this case, he is herein requested to call applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-6146.

Respectfully submitted,

August 1, 2002
Date

Stephen P. Burr
Reg. No. 32,970

SPB:jms

BURR & BROWN
P.O. Box 7068
Syracuse, NY 13261-7068

Customer No.: 025191
Telephone: (315) 233-8300
Facsimile: (315) 233-8320

VERSION OF PARAGRAPH WITH MARKINGS TO SHOW CHANGES MADE

Page 29, line 21 – page 30, line 6:

Reflection angles at the specular reflector 10d may be appropriately determined based on the configuration of switches in accordance with the purposes. In addition to the reflection member to reflect light provided with an inclined surface having predetermined angle as shown in Figs. 1 (a), (b), and (c), the reflection member may include: for example, a plate optical path-changing member 10 arranged in a flat condition at an angle of 0° as shown in Fig. 9. Incidentally, the optical path shown by a broken line in Fig. 9 shows an optical path when the optical path-changing portion ~~9~~8 is brought into contact with the light transmission portion ~~8~~1.

CLEAN VERSION OF PARAGRAPH INCORPORATING CHANGES MADE

Page 29, line 21 – page 30, line 6:

Reflection angles at the specular reflector 10d may be appropriately determined based on the configuration of switches in accordance with the purposes. In addition to the reflection member to reflect light provided with an inclined surface having predetermined angle as shown in Figs. 1 (a), (b), and (c), the reflection member may include: for example, a plate optical path-changing member 10 arranged in a flat condition at an angle of 0° as shown in Fig. 9. Incidentally, the optical path shown by a broken line in Fig. 9 shows an optical path when the optical path-changing portion 8 is brought into contact with the light transmission portion 1.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Abstract of the Disclosure

An optical switch ~~comprises~~includes: at least a light transmission portion, an optical path-changing ~~portion,~~portion and an actuator ~~portion and light transmission channels; said~~portion. The light transmission portion ~~having~~has a light reflecting plane provided on at least one part of a plane facing the optical path-changing portion to totally reflect ~~light; said optical path-changing portion being~~light, and light transmission channels having optical wave guiding bodies and being provided in at least three directions with the light reflecting plane as a starting point. The optical path-changing portion is provided in proximity to the light reflecting plane ~~and having~~of the light transmission portion in a movable condition and has an optical path-changing member for at least reflecting or scattering ~~light; said~~light. The actuator portion ~~having a mechanism being displaced and transmitting~~has a mechanism that is displaced by external signals and transmits the displacement to the optical ~~path changing portion; and said light transmission channels having optical wave guiding bodies and being provided in three directions with the light reflecting plane as a starting point. Switching or dividing of an optical path is conducted by contacting or separating the optical path-changing portion to or from the light reflecting plane by displacement of the actuator portion.~~path-changing portion. The switching or dividing of an optical path is carried out by contacting or separating the optical path-changing portion to or from the light reflecting plane of the light transmission portion by displacement of the actuator portion in response to the external signals. An input light from the light transmission channels is totally reflected at the light reflecting plane of the light transmission portion, and it is transmitted to a specific light transmission channel on an output side when the optical path-changing portion is separated from the light reflecting plane of the light transmission portion. Or an input light is taken from the light transmission channel, is reflected or scattered at the optical path-changing portion, and it is transmitted to a specific one or more light

VERSION WITH MARKINGS TO SHOW CHANGES MADE

transmission channel(s) on the output side when the optical path-changing portion is contacted to the light reflecting plane of the light transmission portion. This optical switch allows low power consumption, makes possible high-speed response, size reduction and high integration, significant reduction of signal attenuation and, furthermore, switching per specific input light.

#3

VERIFICATION OF TRANSLATION

I, Koji Kikawa, state that I am fluent in the English language and in the Japanese language. I hereby verify that the attached English language translation of the Japanese language patent application entitled OPTICAL SWITCH.

Signed this 24th day July, 2002

By____________________
Koji Kikawa